Icarus: The Development of a Voluntary Research Program to Increase Engineering Students’ Engagement

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Abstract

In order to find ways to address problems of motivation and engagement in civil engineering students, and provide students with a space to develop sense of belonging and engage with their peers through a co-curricular experience, the School of Civil Engineering at [BLINDED FOR REVIEW] in 2015 developed the Icarus program. The purpose of this exploratory study is to present preliminary information about the implementation of Icarus, as an engineering education experiment. The program’s goal was to provide students with a different space to develop the competencies and skills desired while simultaneously they form their identity as engineers. The sample was 116 civil engineering students, 49 of them enrolled in the Icarus program in its first semester. Results showed that the main motivation to join the Icarus program was to apply theory from class into engineering real world issues, and to work and engage with peers. In addition, Icarus students have higher levels of aspirations on how well they will do in their engineering courses, and higher levels of deep learning when compared to other non-Icarus engineering students in the same year. Further Implications are provided.

Keywords: Self-belonging, motivation, self-directed learning, co-curricular program, voluntary research.

1. Introduction

Engineering education has been working for decades on methods to increase students’ motivation and engagement in engineering programs. Engagement is seen as an important part of learning in engineering [1-3] as students need to feel a sense of belonging within their academic program in order to effectively develop their identities as engineers. Sense of belonging has been directly linked to successful academic outcomes including persistence, self-efficacy, and perceptions of technical competence [4-6]. In order to feel like they belong, engineering students need to have different systems in place to support and complement their formal education in engineering classrooms. According to Allendoerfer, Wilson [6] those systems come together when students have formal incoming cohorts in classroom and/or labs, and living/learning communities, such as engineering residences where they can interact and develop peer relationships and cohort cohesion, therefore, those spaces are needed as part of the integral college experience. There is also a need for informal spaces to gather with professors and tutors for non-academic reasons in order to develop mentor and role model relationships; and to provide with informal learning opportunities [7].

Results of the National Survey for Student Engagement (NSSE) found that in 2013, more than half of students surveyed in the United States spent at least one hour per seven-day week participating in co-curricular activities such as organizations, campus publications, student governments, fraternities, sororities and intercollegiate or intramural sports. Notably, more than 10% of students spend more than 10 hours per week engaged in some activities (NSSE, 2013). Research also suggests that the majority of a person learning occurs in informal settings, particularly, out-of-the classroom activities [8]. Higher education systems in the United States are designed to provide students with these opportunities, especially cohort development, student engagement, and mentor relationships with academics; however, in Australia the reality is quite different.

According to the Australian Government of Education and Training, in their Higher Education Funding report (2015) one of the main sources of funding in universities in Australia is through the enrolled students, therefore, there has been a tendency of universities in the last years to increase enrollment numbers which results in very high student to staff ratios [9]. Furthermore, students enrolled in engineering programs in large
Universities in Australia have different challenges to develop the engagement and sense of belonging to their engineering program. Large class sizes, low student attendance, and a higher education system structured to limit student-academic and peer-to-peer interactions all present challenges for development of student engagement in engineering schools and faculties. In engineering programs, there is also a culture that pushes for the continuous involvement of students in internships or engineering related work [10], therefore a very large fraction of our students have large working commitments. Finally, students are mainly commuters living at home, thus attendance to class is conditioned by external variables such as transport, schedules, etc. Typical classes have more than 300 students therefore, in several classes students don’t get to meet their peers. In addition, in Australia, digital recording and streaming of lectures has become a standard component of the resources provided to students through learning management sites [11], having an impact on the decrease of student attendance to class, and interaction with their peers.

For the particular case of the School of Civil Engineering at [BLINDED] in Australia, there were serious issues regarding the low motivation students had to interact with academics, which had an impact on their morale. Furthermore, student/staff ratios were very high; hence there was no capacity for any effort from the academics. Some academics felt that undergraduates were unmotivated and that there was no value to engaging with them outside the classroom environment. In order to find ways to address these problems, and provide students with a space to develop sense of belonging and engage with their peers through a co-curricular experience, the School of Civil Engineering in 2015 developed the Icarus program. Icarus is a voluntary, project-based, research program where students engage with peers in small projects, directed by academic mentors, with the goal of establishing a small class atmosphere that promotes peer-to-peer interactions, expands learning beyond the classroom, and provides with mentoring and role modelling relationships. The initial goal of the program was to generate intrinsic motivation in engineering students regarding their civil engineering education [12].

The purpose of this exploratory study is to present preliminary information about the implementation of Icarus, as a radical engineering education experiment. The program’s goal was to provide students with a different space to develop the competencies and skills desired while simultaneously they form their identity as engineers. Icarus is an innovative solution since the School or the Faculty had never offered a co-curricular experience. This study also explores students (i) motivation to participate in the program, and (ii) students initial experiences being part of Icarus. More specifically, we address the following questions:

RQ1: Why do students decide to join a voluntary research program?

RQ2: What are students’ initial perceptions of belonging and self-directed learning after participating in the Icarus program?

In order to answer the research questions, we took a quantitative approach. We asked the students enrolled in the Icarus program, about their attitudes towards the program and towards engineering in general. In addition, we requested during the application process for students to express the reasons why they wanted to participate.

2. Theoretical background

Research by Carini, Kuh [3] has demonstrated that student engagement is linked positively to desirable learning outcomes, such as critical thinking and high academic performance, that positively affect students’
learning outcomes [13]. The Icarus program was thus implemented to make students become engaged with their academic program and their institution.

Floyd-Smith, Wilson [14] argued that when developing a sense of belonging that leads to students’ engagement, it is very important to also develop a community where students can participate and interact with others. Their model is presented in figure 1. According to Floyd-Smith, Wilson [14] when students are engaged (i.e. feel they belong) they will also demonstrate intrinsic motivation, this engagement will lead to short-term and long-term positive academic outcomes.

The Icarus program was structured with this theoretical framework in mind. The expectation was that the students that participate in Icarus, positively engage with their engineering program, and with their peers, but not to the expense of their academic coursework. Icarus emphasized the value of the alignment between the research project offered, and the coursework students were enrolled in. Furthermore, we expected intrinsic motivation in the students that participated in the voluntary research projects. In addition, we hypothesized students were going to develop short-term academic outcomes, like improving their critical thinking, problem solving, and research skills; developing productive relationships with their peers and mentors; and have positive results in the classes in which they are enrolled. Some of the long-term academic outcomes that we expect are students developing as engaged professional engineers that are able to successfully finish their engineering program and effectively adapt to their next step, that being their first professional engineering job, or the decision to continue their education in a higher research degree (i.e. graduate education). Currently, Universities in Australia have very low percentages of students selecting a research career track; however, there is a need in the country to motivate more students to complete a higher degree by research (Report for Research Training in Australia, Department of Innovation, Industry, Science, and Research, 2011). The Icarus program has also the goal of providing students with experiences that allow them to understand that industry internships are only one of many ways of acquiring off classroom skills and to develop professionally. Therefore, we developed the program to let the students guide the way they work and have complete control over their involvement and participation in the program. An important aspect is that the focus was completely removed from outcomes when it came to the students. We encouraged the academics to put projects that resulted in positive research outcomes for them (thus projects had to be very well thought). In contrast, students were not required to achieve or deliver anything, it was their own initiative. A successful project was not one that delivered outcomes but one that delivered engagement.

Although this study is exploratory and we are not measuring any outcome as part of it, we plan to conduct further research in the future to identify and measure the learning and professional outcomes of the Icarus program.
Figure 1. Floyd-Smith, Wilson [14] model of outcomes of students’ engagement

One impact of extracurricular activities on undergraduate students, there is research supporting the notion that out-of-the classroom learning experiences promote students’ engagement with their academic programs among other positive outcomes [5, 15, 16].

Wilson, Jones [15] explains that research suggest that when the student participation in extracurricular activities is voluntary, students have higher levels of “academic conscientiousness” (p.627) which the authors define as a willingness to raise their standards for academic performance, this includes how they perform in the classroom, understand class materials, but also is related to how they conduct research and help and interact with classmates. We consider that Icarus students that are participating in voluntary research projects will gain these positive outcomes.

According to Allendoerfer, Wilson [6], providing students with opportunities to belong help them overcome some of the needs they face during their time in college, and provide “the most return of investment for engagement in academic endeavours” (p. 512). The authors suggested that the most important part of providing sense of belonging and engagement are activities that enable students to receive family-like support, such as [6] (p.531):

- Formal cohorts of incoming students in classroom and/or labs
- Living/learning communities, such as an engineering residence
- Design teams/lab partners, scaffolded for success with respect to the team relationships as well as the project goals
- Weekly informal gatherings with faculty and students for non-academic reasons (e.g., departmental tea, lunches in the dining halls, etc.)
- Service learning opportunities
- Academically-related clubs, with space to meet and ‘hang out’ to facilitate community
The Icarus program was designed to provide several of these activities. Students members of the program consider themselves as being in an Icarus “cohort”, the program also provides scaffolding for general academic success through building team relationships and project goals while they participate in the voluntary research projects and in cross-project activities that highlight the social aspect of the program. These social aspects, provide students with informal spaces to interact with academic mentors and peers in non-academic settings (e.g. end of semester BBQs). In addition, the Icarus program has a room available for the students to facilitate community interactions. These factors align with the criteria proposed by Allendoerfer, Wilson [6] to provide the family-like environment that students need to become engaged and feel they belong.

In addition to sense of belonging and engagement, another theory that informed the creation of the Icarus program is self-directed learning. Baxter-Magolda [17] explains that knowledge is socially constructed based on interactions between the “self” and peers. Therefore, learning environments designed to promote mutual construction of knowledge will also promote self-authorship and provide students with the opportunity of develop learning skills to adapt knowledge to different situations –a desired skills for engineers. Candy [18] explains that learning is rarely a phenomenon that occurs in isolation; rather it usually occurs in the context of social grouping. Self-directed learning provides students with the confidence and power to have agency over what they want to learn and how they do it [18]. In Figure 2 we present a representation of self-directed learning framework based on the work proposed by Baxter-Magolda [17] and Candy [18].

![Figure 2. Self-directed learning adapted from Baxter-Magolda [17] and Candy [18]](image)

The Icarus program promotes self-directed learning in the students that goes beyond their own learning; students recognized and understood that they were contributing to the wellbeing of the School. The School of Civil Engineering also demonstrated its commitment with the students and the Icarus program by the development of several policies and administrative decisions. From the onset, we engaged the Industry Advisory Board with the Icarus program and the Icarus students, the students also actively participate in events, and different type of professional and engagement activities. A side aspect of this is that recruitment and selection processes for new academics in the last years have been profiled to meet this requirement. It is expected that the new academics in the school will see themselves part of a single community of academics and students.
In the following section we provide a full description of the Icarus program, an innovative engineering education initiative to promote sense of belonging, engagement, and self-directed learning in engineering students.

3. The ICARUS Program

The Icarus Program was developed as a pilot engagement program in the School of Civil Engineering at the [BLINDED FOR REVIEW]. Students in the program participate voluntarily in research projects lead by mentors who are part of the academic staff of the department. The Icarus Program was developed with three primary goals:

- to boost undergraduate student interest and experience in diverse and interdisciplinary projects;
- to foster close collaboration between academic mentors and small groups of students, and
- to leverage this engagement to elevate student learning pathways, student career outcomes, and [BLINDED FOR REVIEW]’s national and international reputation for producing the leaders of tomorrow.

The Icarus program was created on several premises:

1. Research programs proposed for Icarus had to be an integral part of the Academic’s research program. It could not be perceived as another task but it had to lead to a productive activity that had value on its own.
2. The objective of the research program had to be aligned with the second year course learning outcomes in such a way that the research experience contributed to the core learning outcomes. Ideally a student could choose only to follow the Icarus learning path and still be assessed for the required learning outcomes of the second year core classes.
3. It had to be voluntary and by application, that way there will be no issues of equality.
4. Admission to the program had to be assessed based on the application and not based on any other indicator (such as GPA), thus motivation was a primary selection criterion.

The program officially started in the first semester of 2015 with four projects across structural, environmental, and transport civil engineering streams. For the initial semester, 60 students were enrolled with the program. Students were in the second year of civil engineering, however, it was the first year in the civil major, since the first-year courses are non-discipline specific engineering classes. Students’ committed 2 to 4 hour per week of work and active contribution in the research project, supervised by an academic mentor, however, the project was intentionally non-structured such that students have to decide and direct how to engage and learn from it. During the first semester, students had 24/7 access to a student-run design studio space, and the opportunity to work closely with project mentors in small settings, and collaborate with motivated peers. In addition, mentors tried to make students apply knowledge that they were acquiring in the second-year classes (structures, environmental, and transport). Hence, there was an intentional overlap of learning outcomes. Students, through the research projects, were acquiring the learning desired for the courses.

The program was developed to complement academic’s teaching and research effort and students’ curricular and extracurricular time. The program allows students and academic to spend more time together on diverse and small-cohort projects with the goal of generating a sense of belonging for the students in the
discipline, and minimizing the barriers and power distance between students and academics. In addition, from a research and educational perspective, the program has been identified as a supplement to the civil learning material with civil research and extended non-civil learning material. By the end of the semester 1 2016, just three semesters after its initial pilot, the Icarus program has grown considerably. It has now 144 students working on 39 different projects. In addition, from having 6 mentors in the initial semester, Icarus has 24 academics serving as mentors for the students in the following areas: environmental, geotechnical, computational mechanics, hydraulics, fire safety, structures, transport, wind, construction management, entrepreneurship, and architecture. There are also several industry-sponsored projects where students have had the chance to not only conduct research and interact with academics but to participate in real-world research solving problems for these companies. In Figure 3 it is possible to perceive part of the growth of the Icarus program over its first 3 semesters.

![Icarus growth graph](image)

In order to contextualize the scope and the range of Icarus projects, we want to describe in this paper some of the projects and the impact they have had in different areas of academia and industry. “The Turbidity Challenge” project is a good example from the research perspective. The goal of the project was to analyze and develop a low-cost turbidity monitoring network to address key issues in coastal management. The students were involved in the completion of the largest and most comprehensive survey of Moreton Bay sediments to date; 220 sites were sampled over a 1500 km² area in a 3-month field campaign with all students participating in both the field work and laboratory analysis. Results from this project were included in the Health Waterways Ecosystem Health Report Card for 2015, which assesses the health of waterways across the entire South East Queensland region. Furthermore, the team was announced a finalist in the Healthy Waterways Awards 2016 People’s Choice Awards. Students who participated in this project have continued the engagement in the project for 3 consecutive semesters to date.
Another projects demonstrated an alignment of learning outcomes between project and class perspective. “The Station Simulation” project was proposed to use virtual technologies to simulate a Bus Rapid Transit (BRT) and find operation scenarios that could reduce or remove peak hour congestion. The project allowed the students to use state-of-the-art simulation software tools to solve a complex local problem. In a small team, students created and analyzed factory, bank, toll booth, airport, and train station models with 2D/3D model animations and learned basic Discrete-Event Simulation (DES) and Agent Based Simulation (ABS) modelling skills. Students re-created the Cultural Centre Busway Station located in Brisbane, Australia as a virtual BRT station simulation model. The students presented their preliminary study results at the 2015 Australian Transport Research Forum (ATRF), under the title of “An agent-based simulation model to evaluate a real-time passenger information system in a Bus Rapid Transit station”. The Station Simulation team won the runner-up for the David Willis Best Poster award.

From an international engagement perspective, the “The TOMMbot” project was a joint research investigation by the School of Civil Engineering at [BLINDED FOR REVIEW] and the Motion Structures Laboratory at Tianjin University in China. The project aimed to build structural “transformers” and determine suitable uses. In brief, it aimed to achieve this with a hybrid origami mechanism that functions as a large, transformable sheet. Students participating in this project were expected to develop creative, user-centred design, and rapid prototyping skills to generate TOMMbot application ideas and build basic prototypes. Consequently, students employed ideation design methods to find applications of the morphing origami technology. They used this to develop a morphing shelter application that was entered into the Road Side Rest Area Design Competition. Their design entry was selected as a Runner Up. Students successfully prototyped a full-scale morphing shelter as well as an experimental-scale deployable shelter. Furthermore, the students visited the Motion Structures Laboratory in Tianjin University in July 2015. They worked in conjunction with Tianjin University graduate students on morphing and rigid origami structures.

Some Icarus projects have also been developed based on industry engagement. For example, one project is trying to improve the CityCat ferry service operations in Brisbane, by creating a demand-based scheduling system that can increase the level of ferry transport serviceability. This project is developed in conjunction with the Brisbane City Council. Also, there have been several projects developed with Brisbane airport to improve the understanding of the experience of both the general public and specific groups (particularly families and passengers with limited mobility and disabilities). In particular, the projects focus on supporting the continuous improvement of BAC’s central security and passenger processing and the Disability Access Facilitation Plan (DAFP) to a ‘world’s best’ standard of customer experience.

In addition to the research projects, Icarus offers students and mentors several social activities throughout the semester. Despite having two academics supporting everything in the program, students decided to create a student management committee that is in charge of the organization, administration, and control of the program. Students in the management committee developed a sense of autonomy and commitment to Icarus, with the goal of growing it sustainably over time with the support of the School of Civil Engineering. The Chair of the student management committee is now a full member of the Industry Advisory Board by petition of the external members of the Board. Furthermore, from a community building perspective, it is important to highlight that most students enrolled in the program to try it for one semester and the majority has decided not to
leave, some of them have expressed that will continue engaging with Icarus projects until the time they graduate, because of the value they find in the program for their identity development as engineers.

4. Methods

In order to address the research questions, data was collected quantitatively. For research question one, we used the application form that students' submitted to participate in Icarus. Responses from the form were quantified in order to identify the reasons students decided to participate. For research question two, we developed a survey that was answered by the students that participated in the projects at the end of the semester 1 2015 (i.e. the end of the first semester of Icarus as a program). The study secured ethical clearance approval.

The sample consisted of 49 engineering students enrolled in their second year, most of them from civil engineering, with some students participating form mechanical and chemical engineering. The sample represented 76.5% of the initial cohort of the Icarus program. All the participants were part of an Icarus project. In the sample, 52% were male and 48% were female, 78% were domestic students and 12% were international. More information about participants’ GPA is shown in figure 4. In addition to the 49 Icarus students, 67 engineering students from the same cohort (i.e. second year) took the survey in order to be able to compare Icarus students’ responses in relation to the other engineering students’ responses.

![GPA of students’ sample](image)

The overarching goal of the study was to understand students’ attitudes towards the Icarus program. The survey was administered in a hard copy version during class, and participating students signed a consent form. The survey was developed with the objective of better understand students’ initial attitudes toward the pilot Icarus program in terms of sense of belonging, engagement and self-directed learning. In order to do that it measured the following constructs:

1. **Identification** with the engineering cohort, which is the degree to which students identify as an engineering student, and feel a sense of connection with other engineering students.
   - E.g., “being an engineering student is an important part of who I am"
2. **Deep learning**, characterised by critical analysis of new ideas and an attempt to extract underlying principles and ideas and translate these into a greater understanding of a topic.
   - E.g., “I find the most engineering topics interesting and often spend extra time trying to obtain more information about them”

3. **Surface learning**, characterised by an emphasis on rote learning and memorisation of details without active engagement with study material.
   - E.g., “I generally restrict my engineering studies to what is specifically set as I think it is unnecessary to do anything extra”

4. **Expectations and aspirations**, assessing how well students think they will perform and hope to perform in their classes.
   - E.g., “Compared to other students, how well do you think you will do in engineering this year?”
   - E.g., “Compared to other students, how well do you hope you will do in engineering this year?”

5. **Relevance and intention**, assessing intentions to complete an engineering degree and perceived utility of engineering degree content for future career prospects.
   - E.g., “I intend to finish my engineering degree”
   - E.g., “How useful is learning engineering for what you want to do after you graduate?”
   - E.g., “How useful is learning engineering for your daily life?”

Since the main goal of this study was to present the Icarus program and to describe students’ initial attitudes toward the program no inferential statistics were conducted between the two groups. We were not interested at this moment in there were significant statistical differences between the two groups, neither the impact that the program caused in the students, rather we were only focused on their initial perceptions about Icarus, and we included the other engineering students only as a point of reference to compare when analyzing the data.

5. **Results**

   The first research question aimed to understand what was the motivation for a student to join and invest time of their own in a voluntary research project. Table 1 summarises the responses from the 49 students. In the discussion section, we elaborate more on these results.

   **Table 1.**

   Students’ motivation to join the Icarus program

<table>
<thead>
<tr>
<th>Why would you like to join the Icarus program?</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apply theory from class into engineering real world issues</td>
<td>27.88%</td>
</tr>
<tr>
<td>Work and engage with peers</td>
<td>15.93%</td>
</tr>
<tr>
<td>Expand interest on specific technical topic</td>
<td>14.60%</td>
</tr>
<tr>
<td>Better understand the engineering profession</td>
<td>8.41%</td>
</tr>
<tr>
<td>Get to know academic mentors</td>
<td>6.64%</td>
</tr>
<tr>
<td>Develop teamwork and interpersonal skills</td>
<td>6.19%</td>
</tr>
</tbody>
</table>
Enhance engineering skills  4.87%
Have hands-on experience  3.10%
Engage in a research / Understand research practices  2.65%
Develop problem-solving skills  2.21%
Participate in extracurricular activities  2.21%
Knowledge beyond the grades  1.77%
Engage in innovative engineering research  1.33%
Enhance resume  1.33%
Have fun  0.88%

It is important to mention that our original intention of alignment with core courses was challenged by these results. We thought this will be an element of value that will encourage the students to participate but it did not register in the survey. Other things seem to matter much more to them. However, many of the academic mentor still see value in connecting the projects being offered to the relevant topics students are learning in their classes, which also matches the first option of the students of applying what they are learning the classroom in a real situation.

The second research question was about students’ initial attitudes of self-belonging and self-directed learning after participating in the Icarus program. Based on our survey responses we provide students responses about sense of belonging: how they identify (figure 5), expectations and aspirations (figure 6), and relevance and intention (figure 7); about self-directed learning: deep learning and surface learning (figure 8). In addition to Icarus students’ responses, we provide second year engineering students’ responses not with the intention of comparing statistical significant differences, but rather as a reference on what are the initial perceptions of the Icarus students.

Figure 5. Students’ responses for identification

Regarding expectations and aspirations (Figure 6) it is possible to see that Icarus students hope that they will do better in their classes compared to other engineering students, however, when asked about their expectations the have lower levels of expectation of doing well in their classes than engineering students.
Regarding self-directed learning, Icarus students showed more deep learning when asked that other engineering students, at the same time engineering students reported more surface learning than Icarus students. Although this data does not demonstrate causality, and it is not possible to make any inferences, this provides with an interesting example of things to study further regarding the Icarus program, and the evaluation of its impact and its learning outcomes.
6. Discussion

Results of the study provided a better understanding of the students’ initial perceptions of the Icarus program after its pilot semester. When students were asked about why they wanted to join an extracurricular program that offered them the option to use their spare time to participate in a voluntary research project, students in the majority responded that they were motivated to participate because they wanted to apply the theoretical knowledge obtained in the classroom into real engineering situations. This aligns with the perceived need for students to belong to their engineering program in their engineering identity development [14]. The second most cited reason students provided was about the need to have a cohort-like experience and get to know their peers, something more difficult to achieve in their large engineering lectures. The need to interact with other engineering students in order to develop professional relationships can also be related to the engagement theory of self-belonging proposed by Allendoerfer, Wilson [6] and Wilson, Jones [15], explained previously.

Another reason students provided for their interest in participating in Icarus was the opportunity to explore and work on a research project of a topic of their choosing. Students wanted to study and use self-directed learning [17] to better understand a specific engineering topic and the opportunity to conduct research on it provided motivation to spend some time engaged in the voluntary program.

Overall, the pilot of the Icarus program has shown to be very successful in the school of civil engineering. Students participating in the program were very engaged with the program, the research they conducted, and their interactions with their peers. Students showed higher levels of engagement, and belonging within the civil engineering program. Icarus has been shown to be part of the solution to the problem of the structure of higher education systems, especially in engineering, where students enrol in large classes and have minimal interaction with their peers and their instructors. Students and mentors participating in Icarus have reported that they feel they not only know and engage better with their peers, but also engaged more in their classes because they have been able to get to know some of the academics of the school outside the classrooms.

7. Further Implications
The Icarus program has grown considerably since it began three semesters ago. The goal of this paper was to present the initial perceptions of the students participating in the program, and also describe the program in detail. Results suggest that understanding the importance of this type of programs to students, and why it enables academic engagement for both students and mentors, can allow educators to encourage and support participation in these types of programs from inside the classroom. It is important to institutionalize Icarus as a successful program in the School of Civil Engineering as it is helping with students’ engagement and sense of belonging, but also with students’ self-directed learning skills. The program is providing students in the School with an option to participate in an extracurricular activity and also to learn more about an engineering topic that they care about.

8. Future Work

We plan to continue conducting research on the Icarus program. As a next step we want to understand which student needs are being met by participation in these types of programs to help educators design opportunities for these needs to be met inside the classroom for the continued benefit to student engagement and achievement.

Furthermore, we will conduct research on the impact of the Icarus program on the desired students’ outcomes. Finally, we want to better understand the students and the mentors’ experiences with this type of program through qualitative means to obtain rich and deep perceptions about the entire Icarus experience.

References


